INDOOR AIR QUALITY ASSESSMENT

Beeman Memorial School
138 Cherry Street
Gloucester, MA 01930

Prepared by:
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Center for Environmental Health
Emergency Response/Indoor Air Quality Program

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Background/Introduction

At the request of the Gloucester Public Schools (GPS), the Massachusetts Department of Public Health's (MDPH) Centers for Environmental Health (CEH) conducted an indoor air quality assessment at the Beeman Memorial School (BMS), 138 Cherry Street, Gloucester, Massachusetts. On December 18, 2004, a visit to conduct an indoor air quality assessment was made to the BMS by Sharon Lee, an Environmental Analyst in CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program, Cathy Gallagher, a Risk Communicator in CEH's Community Assessment Program (CAP) and Josh McHale, Environmental Analyst in CAP. The request was prompted by general indoor air quality and health concerns.

The BMS is a single-story split-level building constructed in 1954. The school consists of classrooms, a gymnasium, a computer room and offices. Windows throughout the school are openable.

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were conducted with the TSI, Q-Trak, IAQ Monitor, Model 8551. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID). MDPH staff performed a visual inspection of building materials for water damage and/or microbial growth.

Results

The school houses approximately 225 students in pre-kindergarten through eighth grade and approximately 30 staff members. Tests were taken during normal operations at the school and results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were above 800 parts per million (ppm) in all areas surveyed, indicating inadequate ventilation in the building. It is important to note that several areas were empty or sparsely populated and/or windows and exterior doors were open in many areas at the time of assessment. Low occupancy and open windows/exterior doors can greatly reduce carbon dioxide levels.

Fresh air in classrooms is supplied by unit ventilator (univent) systems (Picture 1). A univent is designed to draw air from outdoors through a fresh air intake located on the exterior wall of the building (Picture 2) and return air through an air intake located at the base of the unit (Figure 1). Fresh and return air are mixed, filtered, heated and provided to classrooms through an air diffuser located in the top of the unit. Many univents were operating weakly or found to be off at the time of assessment. Obstructions to airflow, such as papers and books stored on univents and bookcases and carts and desks located in front of univent returns, were seen in a few classrooms (Picture 3). In order for univents to provide fresh air as designed, units must be allowed to operate and remain free of obstructions.

Exhaust ventilation in classrooms is provided by ducted, grated closet or wall vents (Pictures 4 and 5) powered by rooftop motors. For rooms with closet exhausts, classroom air is drawn through a space beneath the closet door and into the closet (Picture 6). The exhaust vents located in the upper portions of coat closets remove air. Many closet and wall exhaust vents were not operating or drawing weakly at the time of assessment. Both exhaust vent designs are prone to obstructions. Some closet exhausts were obstructed by items placed in front of floor level openings and/or items placed on shelves below the vent. A number of wall exhaust vents were also obstructed by desks, bookcases and other items (Picture 7). In addition, several classroom wall vents are located near hallway doors (Picture 5). When these classroom doors are open, exhaust vents for these rooms will tend to draw air from both the hallway and the classroom, reducing the effectiveness of the exhaust vent to remove common environmental pollutants. As with the univents, in order to function properly, exhaust vents must be activated and remain free of obstructions.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room, while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years (SMACNA, 1994). The date of the last balancing was not available at the time of the assessment.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please consult Appendix A.

Temperature measurements ranged from 67° F to 73° F, which were within or slightly below the MDPH recommended comfort guidelines in some areas. The MDPH recommends that indoor air temperatures be maintained in a range of 70 ° F to 78 ° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measurements in the building ranged from 33 to 45 percent, which were within or slightly below the MDPH recommended comfort range. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

A few areas had water-damaged ceiling tiles (Pictures 8 and 9), which can indicate leaks from the roof or plumbing system. Water-damaged ceiling tiles can provide a source for mold growth and should be replaced after a water leak is discovered and repaired. Tiles glued directly to the ceiling system are more difficult to remove (Picture 9); appropriate precautions should be taken when removing and replacing these tiles.

Swelling wood paneling was also observed around some skylights (Picture 10). Swelled wood can indicate chronic wetting and is an indication of a potential roof leak. It is recommended that the roof membrane and/or flashing around skylights be assessed for damage and repairs be made as necessary.

Open seams between sink countertops and walls were observed in several rooms. If not watertight, water can penetrate through the seam, causing water damage. Water penetration and chronic exposure of porous and wood-based materials can cause these materials to swell and show signs of water damage. Moistened materials that are not dried within 24 to 48 hours can become potential sources for mold growth.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy porous materials is not recommended.

Plants were also observed in several classrooms (Picture 11). Some plants were found on top of univents (Picture 3). A slight musty odor was detected in one classroom, where a bag of deteriorating tree leaves was found next to the univent (Picture 12). Plants, soil and drip pans can serve as sources of mold growth, thus should be properly maintained. Over-watering of plants should be avoided and drip pans should be inspected periodically for mold growth. Plants and related materials should also be located away from ventilation sources to prevent aerosolization of dirt, pollen, odors or mold.

A number of aquariums and terrariums were located in classrooms. Aquariums should be properly maintained to prevent microbial/algae growth, which can emit unpleasant odors. Similarly, terrariums should be properly maintained to ensure soil does not become a source for mold growth.

Plants were observed to be growing against the foundation walls (Picture 13). The growth of roots against exterior walls can bring moisture in contact with the foundation. Plant roots can eventually penetrate, leading to cracks and/or fissures in the sublevel foundation. Over time, this process can undermine the integrity of the building envelope, providing a means of water entry into the building via capillary action through foundation concrete and masonry (Lstiburek & Brennan, 2001).

Lastly, standing water was noted in some outdoor planters (Picture 14) in close proximity to a univent fresh air intake. Stagnant water can be a source of unpleasant odors and microbial growth. Since the planters are near an air intake, odors can be entrained by the univent and subsequently be distributed. In addition, stagnant pools of water can serve as a breeding ground for mosquitoes.

Other Concerns

Indoor air quality can be negatively influenced by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion emissions include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, CEH staff obtained measurements for carbon monoxide and PM2.5.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

The American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2000a). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS levels (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2000a).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. On the day of assessment, outdoor carbon monoxide concentrations were non-detect (ND) (Table 1). Carbon monoxide levels measured in the school were also ND.

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits to particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 microgram per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2000a). These standards were adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA proposed a more protective standard for fine airborne particles. This more stringent PM2.5 standard requires outdoor air particle levels be maintained below 65 $\mu g/m^3$ over a 24-hour average (US EPA, 2000a). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective proposed PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. Outdoor PM2.5 concentrations were measured at 6 $\mu g/m^3$ (Table 1). PM2.5 levels measured in the school were between 8 to 78 $\mu g/m^3$, which were above outdoor measurements and the NAAQS of 65 $\mu g/m^3$in a few areas (Table 1). Frequently, indoor air levels of particulates can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulates during normal operation. Sources of indoor airborne particulate may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices, operating an ordinary vacuum cleaner and heavy foot traffic indoors. The PM2.5 levels measured at the BMS reflect the dust load within the school.

In addition to typical school activities, dust control appeared to be a significant problem at the time of assessment. A large number of surfaces throughout the school were found with accumulated dust (Picture 15). Supply and return vents for univents, exhaust vents and fan blades to personal fans were also occluded with dust (Pictures 16 to 18). Reactivated fans and univents can serve to distribute accumulated dust. If exhaust vents become deactivated, backdrafting can result in the re-aerosolization of accumulated dust particles. Dust can be irritating to the eyes, nose and respiratory tract. Flat surfaces should be wet wiped and cleaned with a vacuum equipped with the high efficiency particulate arrestance (HEPA) filter on a regular basis.

Indoor air quality can also be negatively influenced by the presence of materials containing volatile organic compounds (VOCs). VOCs are carbon-containing substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. An outdoor air sample was taken for comparison. Outdoor TVOC concentrations were ND (Table 2). Indoor TVOC concentrations were ND in all but one area. A TVOC reading of 1 ppm was made in classroom 11, where CEH staff detected dry erase marker odors.

Please note, TVOC air measurements are only reflective of the indoor air concentrations present at the time of sampling. Indoor air concentrations can be greatly impacted by the use of TVOC containing products. In an effort to identify materials that can potentially increase indoor TVOC concentrations, CEH staff examined classrooms for products containing these respiratory irritants. Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Cleaning products and air deodorizers were found on countertops and in unlocked cabinets beneath sinks in some classrooms (Picture 19). Like dry erase materials, cleaning products contain VOCs and other chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. Use of air deodorizers aerosolizes VOCs; thus, instead of removing the materials causing odors, the odors are masked.

Teaching staff indicated a number of concerns regarding appropriate use of cleaning chemicals used by the custodial staff. Material safety data sheets (MSDSs) and fact sheets regarding the intended use for each cleaning agent should be made available. Teaching and custodial staff should both be trained to ensure the suitable cleaners are used and placed in an appropriate manner in lockable areas.

Floor tiles throughout the hallway were damaged or missing (Pictures 20 and 21). School officials report that the darker floor tiles contain asbestos. Intact asbestos-containing materials do not pose a health hazard. If damaged, asbestos-containing materials can be rendered friable and become aerosolized. Considering that asbestos-containing tiles are predominately in the hallways, materials from broken tiles are more likely to be aerosolized in this high occupancy area. Friable asbestos is a chronic (long-term) health hazard, but will not produce acute (short-term) health effects (e.g., respiratory symptoms, headaches) typically associated with buildings believed to have indoor air quality problems. Where asbestos-containing materials are found damaged, these materials should be removed or remediated in a manner consistent with Massachusetts asbestos remediation laws (MDLI, 1993).

Univents are normally equipped with filters that strain particulates from airflow. The univent filters at the BMS provide minimal filtration of respirable dusts. In order to decrease aerosolized particulates, disposable filters with an increased dust spot efficiency can be installed. The dust spot efficiency is the ability of a filter to remove particulates of a certain diameter from air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent would be sufficient to reduce airborne particulates (Thornburg, 2000; MEHRC, 1997; ASHRAE, 1992). Note that increased filtration can reduce airflow produced by increased resistance, a condition known as pressure drop. Prior to any increase of filtration, univents should be evaluated by a ventilation engineer to ascertain whether they can maintain function with filters that are more efficient.

Also of note was the amount of materials stored inside classrooms (Picture 22). In classrooms throughout the school, items were seen on windowsills, tabletops, counters, bookcases and desks. The amount of items stored provides a means for dusts, dirt and other potential respiratory irritants to accumulate. Many of the items (e.g. papers, folders, boxes) make it difficult for custodial staff to clean. To facilitate cleaning and reduce dust load in the school, staff should work with the BMS administration to improve classroom organization. In general, a written request system should be developed to allow teaching staff to relay concerns to the building management /maintenance department in a manner to allow for a timely remediation of the problem (Appendix C).

Breaches and holes were noted around wall pipes and within the univent air-handling cabinets (Pictures 23 and 24). Breaches and open holes should be sealed to prevent the movement of odors and particulates from unoccupied to occupied areas.

Accumulated chalk dust was noted in some classrooms. Chalk dust is a fine particulate that can easily become aerosolized, irritating eyes and the respiratory system.

Similarly, pencil shavings were observed to be accumulating at the base of pencil sharpeners. Open windows and operating ventilation can aerosolize chalk dust and pencil shavings.

A number of classrooms contained upholstered furniture and pillows (Picture 3). Upholstered furniture is covered with fabric that encounters human skin. This type of contact can leave oils, perspiration, hair and skin cells. Dust mites feed upon human skin cells and excrete waste products that contain allergens. In addition, if relative humidity levels increase above 60 percent (e.g., during spring/summer), dust mites tend to proliferate (US EPA, 1992). In order to remove dust mites and other pollutants, frequent vacuuming of upholstered furniture is recommended (Berry, 1994). It is also recommended that if upholstered furniture were present in schools, it should be professionally cleaned on an annual basis or every six months if dusty conditions exist outdoors (IICR, 2000).

A birds' nest was noted on a table (Picture 25). Nests can contain bacteria and may also be a source of allergenic material. Nests should be placed in resealable bags to prevent aerosolization of allergenic material.

Lastly, in an effort to reduce noise from sliding chairs, tennis balls had been spliced open and placed on chair legs (Picture 26). Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and off gas VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix B (NIOSH, 1998).

Health Concerns

On August 6, 2004, the CEH received a written request from Brian Tarr, Assistant Superintendent of the GPS, to investigate a suspected increase in cancer incidence among staff at the BMS. The purpose of the investigation was to determine whether the pattern of cancer was atypical or possibly related to a common environmental factor within the building. The original request received from the Assistant Superintendent did not contain any information on individuals with a reported diagnosis of cancer. Staff in the CEH ER/IAQ Program learned of concerns at the BMS from Cindy Juncker, School Nurse Leader for the GPS, during an inspection of another building in Gloucester. Staff in the ER/IAQ Program recommended that Nurse Juncker contact CAP staff in order to discuss the CAP protocol for evaluating suspected disease clusters in a workplace setting. As a follow-up to her conversation with ER/IAQ Program staff, Nurse Juncker contacted CAP staff and reported that approximately 23 staff members at the BMS had been diagnosed with cancer and other illnesses within the last six to seven years. However, at the time of the telephone conversation with Nurse Juncker, specific diagnosis information on each staff person diagnosed with cancer was not available. CAP staff asked Nurse Juncker to submit information on each current and former staff member diagnosed with cancer including primary site of cancer, approximate age and date of diagnosis, and approximate dates of employment at the BMS. This request for information on each staff member is consistent with the CEH protocol for conducting health assessments of cancer among occupants in buildings.

In October 2004, the CEH received a follow up letter from the Assistant Superintendent of the GPS that contained a list of 12 current and former employees of the school who had reported a diagnosis of cancer. Name, primary site of cancer, approximate date of diagnosis, and approximate dates of employment at the school were reported for each individual. Approximate age at diagnosis however was not provided for any of these employees. Following a CAP follow-up request for missing information, Mark Kennefick, Principal of the BMS, provided the approximate age at diagnosis for all 12 individuals.

CAP staff reviewed the most recent data available from the Massachusetts Cancer Registry (MCR) and the Registry of Vital Records and Statistics to confirm cancer diagnoses reported among BMS employees and to determine whether these diagnoses may represent an unusual pattern of cancer incidence. The MCR, a division within the MDPH's Center for Health Information, Statistics, Research and Evaluation, is a population based surveillance system that has been monitoring cancer incidence in the Commonwealth since 1982. All new diagnoses of invasive cancer among Massachusetts residents are required by law to be reported to the MCR within six months of the date of diagnosis (M.G.L. c.111. s 111b). Some non-cancerous (i.e., benign) tumors of the brain and central nervous system (CNS) are reported to the MCR, however, benign tumors of other organs are not included in the MCR data files. This information is collected and kept in a confidential database. Data are collected on a daily basis and reviewed for accuracy and completeness on an annual basis. This process corrects misclassification of data (i.e., city/town misclassification) and deletes duplicate case reports.

CAP personnel were able to confirm cancer diagnoses for four of the 12 individuals through the MCR however, it is important to note that four individuals were reported as having benign tumors of various types. As mentioned above only benign tumors of the brain and CNS are reported to the MCR. Three different benign conditions were reported among these four individuals. Review of the literature and coding from the International Classification of Diseases for Oncology (ICD-O) system indicates that one of the benign conditions listed is considered to be a benign brain tumor. While any diagnosis of cancer or other benign conditions is distressing it is important to remember that there is a significant medical difference between invasive cancers and benign tumors. Malignant (or invasive) cancers act differently than benign tumors. They behave in an aggressive manner by growing quickly and invading other tissue in the body. Benign tumors do not have the ability to spread throughout the body and therefore, are not classified as cancer (Adami, 2002). Although the exact causes of the pre-cancerous conditions listed among BMS employees remains unknown, review of current medical and scientific literature did not indicate that an environmental exposure was associated with any of these conditions. For the remaining eight individuals seven different primary site cancers were reported.

As discussed, four individual's diagnoses were confirmed via the MCR. These four individuals were diagnosed with three different diseases [breast cancer, melanoma and non-Hodgkin's Lymphoma (NHL)] over a seven-year time period indicating no apparent trend in diagnoses over time. Based on the current scientific and medical literature, the three cancer types are not thought to share common risk factors related to their development, and with respect to melanoma other than exposure to sunlight, environmental factors are not related to development of this disease. Please refer to Appendix D for more information regarding risk factors for breast cancer, melanoma, and NHL.

Through a search of Massachusetts death records available from the Registry of Vital Records and Statistics, another division within the MDPH Center for Health Information, Statistics, Research and Evaluation, CAP staff were able to confirm the cause of death for one former employee of the BMS who had been reported to the CEH with a diagnosis of cancer but was not among the four individuals confirmed in the MCR. The type of cancer listed on this individual's death certificate (i.e., metastatic melanoma) was different than that reported to the CEH by school authorities. As mentioned above, the major risk factor associated with melanoma is exposure to sunlight.

Cancer in general has a long period of development or latency period (i.e., the interval between first exposure to a disease-causing agent and the appearance of symptoms of the disease [Last 1995]) that can range from 10 to 30 years and in some cases may be more than 40 to 50 years for solid tumors (Bang, 1996; Frumkin, 1995). Although it is not possible to determine what may have caused any one person's diagnosis with cancer, the length of time in which an individual worked in a particular building can help determine the importance that their location might have in terms of exposure to a potential environmental source. Two of the four staff members with a confirmed diagnosis of cancer in the MCR reportedly worked at the BMS between 10 and 20 years prior to their diagnoses. Information reported on the other two staff members confirmed in the MCR indicated that they each began their employment at the school between 35 and 40 years prior to their diagnoses but have not been employed at the school for some time. In addition, one of these individuals was diagnosed with melanoma, a cancer type not thought to be associated with an environmental exposure. Based on the date of diagnosis and length of employment reported to the CAP for the seven staff members who could not be identified in the MCR, one individual worked at the school less than five years, two individuals worked between five and 10 years, three individuals between 10 and 20 years, and one individual worked at the school between 20 and 30 years. Although several staff members confirmed in the MCR and reported to the CEH with a diagnosis of cancer were long term employees of the BMS, a number of different cancer types and benign conditions were reported among these individuals. Therefore, it is less likely that a common environmental factor played a role in the diagnoses of these individuals.

CAP staff were not able to confirm the diagnoses of seven of the 12 individuals reported to the CEH. Although we reviewed the MCR data for cancer diagnoses through the present time, it is possible that some residents of Massachusetts diagnosed with cancer may not yet be included in the MCR files. For example, some individuals may have been diagnosed prior to 1982 when the MCR began collecting information on individuals in the state diagnosed with cancer. Similarly, individuals with recent cancer diagnoses (e.g., 2004 and 2005) may not have been reported to the MCR yet or their file may not yet be available for review. With the exception of benign brain tumors, individuals diagnosed with either pre-cancerous or non-cancerous conditions would not be included in the MCR data files. Finally, a diagnosis of cancer may have been incorrectly reported for some individuals.

It is important to keep in mind that cancer is a common disease. The American Cancer Society estimates that one out of every three Americans will develop some type of cancer during his or her lifetime. Over the past forty years, the rise in the number of cancer cases generally reflects the increase in the population, particularly in the older age groups. However, although most cancer types occur more frequently in older populations (i.e. age 50 and over); cancer can affect people of all ages. The most commonly diagnosed cancers for adult males include cancers of the prostate, lung and bronchus, and colon. Breast, lung and bronchus, and colon cancers are the most common cancer types diagnosed among females (ACS, 2005).

Understanding that cancer is not one disease, but a group of diseases is also very important. Research has shown that there are more than 100 different types of cancer, each with different causative (or risk) factors. In addition, cancers of a certain tissue type in one organ may have a number of causes. Cancer may also be caused by one or several factors acting over time. For example, tobacco use has been linked to lung, bladder, and pancreatic cancers. Other factors related to cancer may include lack of crude fiber in the diet, high fat consumption, alcohol abuse, and reproductive history. Heredity, or family history, is an important risk factor for several cancers. To a lesser extent, some occupational exposures, such as jobs involving contact with asbestos, have been shown to be carcinogenic (cancer causing). Environmental contaminants have also been associated with certain types of cancer (Bang, 1996; Frumkin, 1995).

According to American Cancer Society statistics, cancer is the second leading cause of death in Massachusetts and the United States. Not only will one out of three people develop cancer in their lifetime, but this tragedy will affect three out of every four families. For this reason, cancers often appear to occur in "clusters," and it is understandable that someone may perceive that there are an unusually high number of cancer cases in their surrounding neighborhoods or towns. Upon close examination, many of these “clusters” are not unusual increases, as first thought, but are related to such factors as local population density, variations in reporting or chance fluctuations in occurrence. In other instances, the “cluster” in question includes a high concentration of individuals who possess related behaviors or risk factors for cancer. Some, however, are unusual; that is, they represent a true excess of cancer in a workplace, a community, or among a subgroup of people. A suspected cluster is more likely to be a true cancer cluster if it involves a large number of cases of one type of cancer diagnosed in a relatively short time period rather than several different types diagnosed over a long period of time (i.e., 20 years), a rare type of cancer rather than common types, and/or a large number of cases diagnosed among individuals in age groups not usually affected by that cancer. These types of clusters may warrant further public health investigation.

Based upon our review of the available diagnosis information, as well as the most current cancer literature, there does not appear to be an atypical pattern of cancer diagnoses among current and former employees of the BMS in Gloucester. That is, it does not appear that a common factor (either environmental or non-environmental) is likely related to diagnoses of cancer among these individuals. Additionally, while potential indoor air quality problems were noted in this report, these issues are not likely to be related to the incidence of cancer among employees at BMS, but probably have contributed to common symptoms associated with poor indoor air quality (e.g., headaches, irritant symptoms).

Recommendations

The conditions noted at the BMS raise a number of indoor air quality issues. In addition to the IAQ assessment, CEH staff also evaluated information in an attempt to identify possible environmental sources that have been suggested to play a role in the cancer development. **No evidence of environmental sources associated with the disease was identified in or around the building**. A number of minor issues regarding general building conditions, design and routine maintenance that can affect indoor air quality were observed. These factors can be associated with a range of IAQ related health and comfort complaints (e.g., eye, nose, and respiratory irritations), but they are unlikely to be associated with cancer occurrences among employees. In view of the findings at the time of the visit, the following recommendations are made:

1. Operate both supply and exhaust ventilation continuously, independent of classroom thermostat control, during periods of school occupancy to maximize air exchange.
2. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Operate univents while classrooms are occupied. Check fresh air intakes for repair and increase the percentage of fresh air intake if necessary.
3. Consider increasing filter dust spot efficiency for HVAC equipment.
4. Remove all blockages from univents and exhaust vents to ensure adequate airflow. Clean univent and exhaust vents periodically to prevent excessive dust build-up.
5. Close classroom doors to maximize exhaust function.
6. Use openable windows in conjunction with classroom univents and exhaust vents to increase air exchange. Care should be taken to ensure windows are properly closed at night and weekends to avoid the freezing of pipes and potential flooding.

7. Consult a ventilation engineer concerning balancing of the ventilation systems. Ventilation industrial standards recommend that mechanical ventilation systems be balanced every five years (SMACNA, 1994).
8. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
9. Remove plants from the wall/tarmac junction around the perimeter of the building. Seal the wall/tarmac junction with an appropriate sealer.
10. Ensure all roof leaks are repaired. Replace any remaining water-stained ceiling tiles in the dropped ceiling tile system. Examine the areas above and around these tiles for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.
11. Consider removal of glued ceiling tiles as a renovations activity. Removal of tiles directly adhered to the ceiling would be considered a renovation activity, since tile removal can release particulates and spores in particular, if the material is moldy. Replacement of ceiling tiles may involve glues that contain VOCs. In order to minimize occupant exposure, repairs should be done while the building is unoccupied.

12. Consult with a roofing contractor to examine roofing and flashing around skylights, make repairs as needed.
13. Relocate plants and plant materials away from univents.
14. Clean and maintain aquariums and terrariums to prevent mold growth and associated odors.
15. Empty standing water from planters and/or move away from univent fresh air intakes.
16. Remediate damaged floor tiles in conformance with Massachusetts asbestos remediation and hazardous waste disposal laws.
17. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
18. Clean accumulated dust from exhaust vents and blades of personal fans.
19. Clean chalkboard/dry erase marker trays and pencil sharpeners regularly to prevent the build-up of excessive chalk dust and particulates.
20. Consider training staff in chemical safety and cleanliness techniques. Consider maintaining a chemical inventory of agents available for use by faculty and/or staff.
21. Store cleaning products properly and out of reach of students.
22. Store nests in re-sealable bags to prevent aerosolization of irritants.
23. Consider developing a written notification system for building occupants to report indoor air quality issues/problems, if one is not already in place (Appendix C). Have these concerns relayed to the maintenance department/ building management in a manner to allow for a timely remediation of the problem.

24. Seal breaches and holes in walls and floors in univent cabinets to prevent movement of materials to occupied areas.

25. Discontinue the use of tennis balls on chairs to prevent latex dust generation.

26. Refrain from using strongly scented materials (e.g., air fresheners) in classrooms.

27. Clean upholstered furniture on the schedule recommended in this report. If not possible/practical, remove upholstered furniture from classrooms.

28. Consider adopting the US EPA (2000b) document, *Tools for Schools*, in order to provide self-assessment and maintain a good indoor air quality environment. The document can be downloaded from the Internet at http://www.epa.gov/iaq/schools/index.html.

29. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH's website: http://mass.gov/dph/indoor_air

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Picture 1

Classroom univent, note items placed on top of unit

Picture 2

Univent fresh air intake

Picture 3

Obstructions on top and in front of univent

Picture 4

Closet vent

Picture 5

Wall vent

Picture 6

Undercut sliding closet door

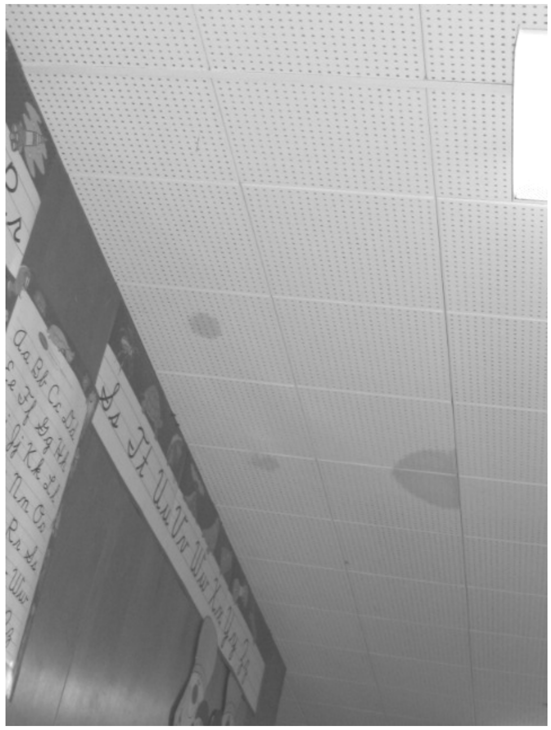
Picture 7

Obstructed exhaust vent

Picture 8

Water-damaged ceiling tiles

Picture 9



Water damaged glued ceiling tiles

Picture 10

Water-damaged wood around hallway skylight

Picture 11

Plants in classrooms

Picture 12

Bag of tree leaves near univent

Picture 13

Plant growth against building foundation

Picture 14

Planter with debris and water

Picture 15

Dust coating floor

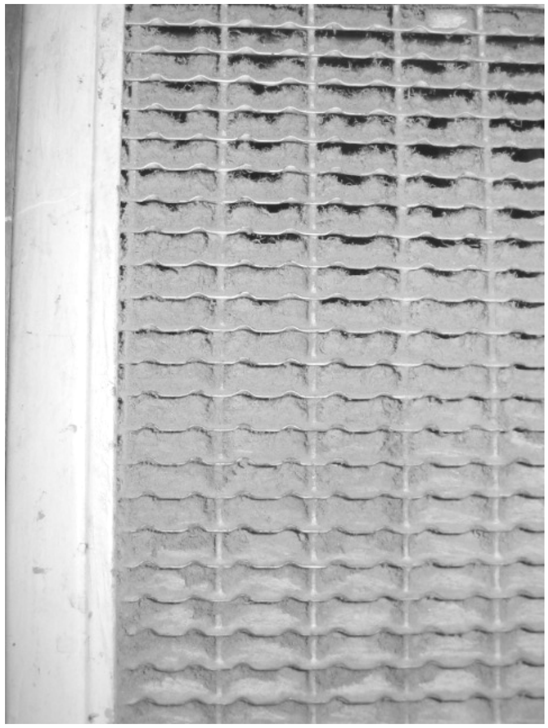
Picture 16

Dust occluding univent return vent

Picture 17

Dust on fan blades

Picture 18



Dust occluded exhaust vent

Picture 19

Cleaners and air deodorizers

Picture 20

Missing hallway floor tiles

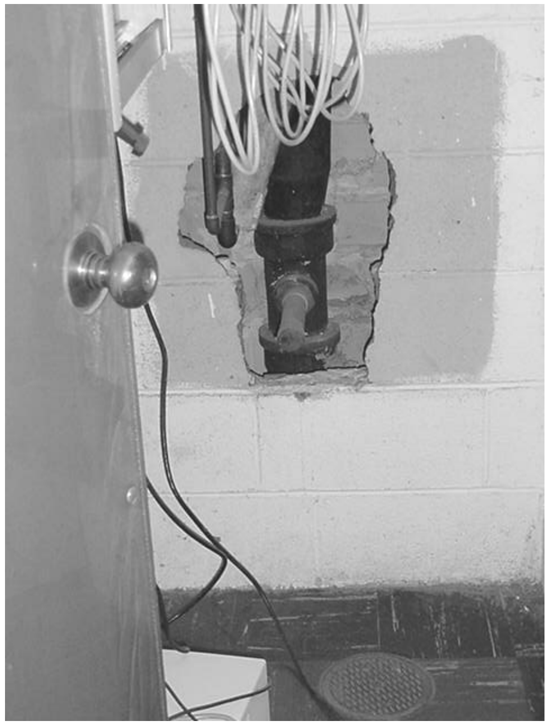
Picture 21

Broken floor tiles

Picture 22

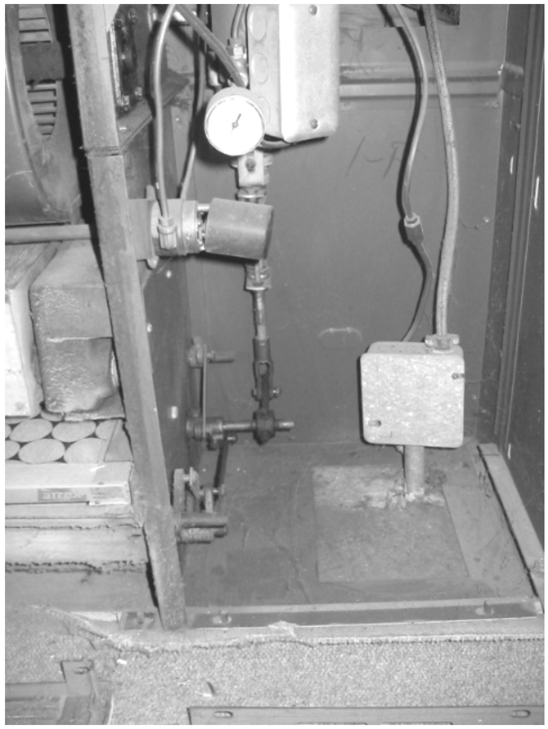
Storage of materials in classroom

Picture 23



Breach in wall around pipes

Picture 24



Breaches in univent air handling cabinet

Picture 25

Birds' nest

Picture 26

Tennis Balls

Beeman Memorial School

138 Cherry Street, Gloucester, MA 01930

Table 1

Indoor Air Results

December 10, 2004

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
background	0	45	68	388	ND	ND	6	N # open: 0 # total: 0			Comments: overcast, misty.
copy room	1	69	38	927	ND	ND	25	N # open: 0 # total: 0	N	Y wall (off)	Hallway DO, wet toner copier, Comments: breaches in wall around pipes.
gym	27	67	34	1117	ND	ND	66	N # open: 0 # total: 0	Y wall (off) dust/debris	Y wall (off)	
Main office	3	73	39	1147	ND	ND	28	N # open: 0 # total: 0	N	N	Hallway DO, Inter-room DO, plants.
nurses' inner office	0	73	36	1101	ND	ND	16	Y # open: 0 # total: 0	N	N	Inter-room DO, plants.
nurses' main office	3	71	37	1059	ND	ND	23	N # open: 0 # total: 0	N	N	Hallway DO
principals office	0	71	37	1091	ND	ND	18	Y # open: 0 # total: 2	N	N	Inter-room DO, #MT/AT: 1, plants.
resource room	4	70	38	962	ND	ND	13	Y # open: 0 # total: 0	Y univent (off) items	Y wall (off) (BD) items	Hallway DO, #WD-CT: 2, #MT/AT : 1, PF, TB, cleaners, items, plants.

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
	> 800 ppm = indicative of ventilation problems		

Beeman Memorial School

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Table 1

Indoor Air Results

December 10, 2004

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
1	16	67	41	1157	ND	ND	37	Y # open: 0 # total: 2	Y univent (off)	Y closet (off) items dust/debris	Hallway DO, DEM, items, dust.
2 (music)	0	67	41	863	ND	ND	14	Y # open: 0 # total: 2	Y univent (off)	Y closet (off)	Hallway DO,
3	22	69	42	1317	ND	ND	33	Y # open: 0 # total: 2	Y univent items	Y closet (off)	Hallway DO, CD, DEM, items, dust, plants, Comments: water bottles on univent.
4 (computer room)	0	70	33	829	ND	ND	10	N # open: 0 # total: 0	Y univent furniture	Y closet (off) items	CD, DEM, Comments: WD-sink.
5 (library)	2	69	37	913	ND	ND	8	Y # open: 0 # total: 2	Y univent boxes items	Y closet (off)	Hallway DO,
6	20	70	42	2130	ND	ND	78	Y # open: 0 # total: 2	Y univent items	Y closet (off) dust/debris	Hallway DO, CD, DEM, PF, cleaners, Comments: WD-sink counter.
7 (art)	0	72	36	1187	ND	ND	28	Y # open: 0 # total: 2	Y univent	Y wall (off) dust/debris	Hallway DO, CD, DEM, PF.
8	21	71	43	2082	ND	ND	51	Y # open: 0 # total: 2	Y univent (weak)	Y wall (off)	Hallway DO, AD, DEM, UF, cleaners, items, dust, FC re-use, plants, Comments: burning coffee odor.

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
	> 800 ppm = indicative of ventilation problems		

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Table 1

Indoor Air Results

December 10, 2004

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
9	0	72	58	1641	ND	ND	22	Y # open: 0 # total: 2	Y univent	Y wall (off) items	Hallway DO, #WD-CT: 4, CD, DEM, cleaners.
10	22	69	44	1808	ND	ND	23	Y # open: 0 # total: 2	Y univent (weak)	Y wall (off) items	CD, DEM, cleaners, FC re-use, plants.
11	22	72	45	2995	ND	1	74	Y # open: 0 # total: 2	Y univent (weak)	Y wall items dust/debris	Hallway DO, DEM, dust, Comments: students left approximately 5 min before testing; DEM odors; dripping faucet; broken floor tiles.
12	0	70	38	1165	ND	ND	16	Y # open: 0 # total: 2	Y univent items	Y wall (off)	Hallway DO, #WD-CT : 1, CD, PS, aqua/terra.
13	0	71	44	1935	ND	ND	23	Y # open: 0 # total: 2	Y univent	Y wall (off)	Hallway DO, CD, DEM, PF.
14	0	71	36	903	ND	ND	15	Y # open: 0 # total: 2	Y univent (weak)	Y wall (off)	Hallway DO, CD, plants.
15	1	71	42	1818	ND	ND	18	Y # open: 0 # total: 2	Y univent boxes items plant(s)	Y wall (off)	Hallway DO, DEM, PF, TB, cleaners, items, Comments: 23 students left approximately 10 min prior to assessment; musty odor from leaves near univent.
16	0	71	41	1417	ND	ND	13	Y # open: 0 # total: 2	Y univent	Y wall (off)	Hallway DO, DEM, TB, cleaners, items.

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
	> 800 ppm = indicative of ventilation problems		

Appendix D

RISK FACTOR INFORMATION FOR SELECTED CANCER TYPES

Breast Cancer

Breast cancer is the most frequently diagnosed cancer among women in both the United States and in Massachusetts. According to the North American Association of Central Cancer Registries, female breast cancer incidence in Massachusetts is the fifth highest among all states (Chen et al, 2000). Although during the 1980s breast cancer in the U.S. increased by about 4% per year, the incidence has leveled off to about 110.6 cases per 100,000 (ACS 2000). A similar trend occurred in Massachusetts and there was even a slight decrease in incidence (1%) between 1993 and 1997 (MCR 2000).

In the year 2005, approximately 211,240 women in the U.S. will be diagnosed with breast cancer (ACS 2005). Worldwide, female breast cancer incidence has increased, mainly among women in older age groups whose proportion of the population continues to increase as well (van Dijck, 1997). A woman's risk for developing breast cancer can change over time due to many factors, some of which are dependent upon the well-established risk factors for breast cancer. These include increased age, an early age at menarche (menstruation) and/or late age at menopause, late age at first full-term pregnancy, family history of breast cancer, and high levels of estrogen. Other risk factors that may contribute to a woman's risk include benign breast disease and lifestyle factors such as diet, body weight, lack of physical activity, consumption of alcohol, and exposure to cigarette smoke. Data on whether one's risk may be affected by exposure to environmental chemicals or radiation remains inconclusive. However, studies are continuing to investigate these factors and their relationship to breast cancer.

Family history of breast cancer does affect one's risk for developing the disease. Epidemiological studies have found that females who have a first-degree relative with premenopausal breast cancer experience a 3-fold greater risk. However, no increase in risk has been found for females with a first degree relative with postmenopausal breast cancer. If women have a first-degree relative with bilateral breast cancer (cancer in both breasts) at any age then their risk increases five-fold. Moreover, if a woman has a mother, sister or daughter with bilateral premenopausal breast cancer, their risk increases nine fold. (Broeders and Verbeek, 1997). In addition, twins have a higher risk of breast cancer compared to non-twins (Weiss et al, 1997).

A personal history of benign breast disease is also associated with development of invasive breast cancer. Chronic cystic or fibrocystic disease is the most commonly diagnosed benign breast disease. Women with cystic breast disease experience a 2-3 fold increase in risk for breast cancer (Henderson et al, 1996).

According to recent studies, approximately 10% of breast cancers can be attributed to inherited mutations in breast cancer related genes. Most of these mutations occur in the BRCA1 and BRCA2 genes. Approximately 50% to 60% of women who inherit BRCA1 or BRCA2 gene mutations will develop breast cancer by the age of 70 (ACS 2001).

Cumulative exposure of the breast tissue to estrogen and progesterone hormones may be one of the greatest contributors to risk for breast cancer (Henderson et al, 1996). Researchers suspect that early exposures to a high level of estrogen, even during fetal development, may add to one's risk of developing breast cancer later in life. Other studies have found that factors associated with increased levels of estrogen (i.e., neonatal jaundice, severe prematurity, and being a fraternal twin) may contribute to an elevated risk of developing breast cancer (Ekbom et al, 1997). Conversely, studies have revealed that women whose mothers experienced toxemia during pregnancy (a condition associated with low levels of estrogen) had a significantly reduced risk of developing breast cancer. Use of estrogen replacement therapy is another factor associated with increased hormone levels and it has been found to confer a modest (less than two-fold) elevation in risk when used for 10-15 years or longer (Kelsey, 1993). Similarly, more recent use of oral contraceptives or use for 12 years or longer seems to confer a modest increase in risk for bilateral breast cancer in premenopausal women (Ursin et al, 1998).

Cumulative lifetime exposure to estrogen may also be increased by certain reproductive events during one's life. Women who experience menarche at an early age (before age 12) have a 20% increase in risk compared to women who experience menarche at 14 years of age or older (Broeders and Verbeek, 1997; Harris et al, 1992). Women who experience menopause at a later age (after the age of 50) have a slightly elevated risk for developing the disease (ACS 2001). Furthermore, the increased cumulative exposure from the combined effect of early menarche and late menopause has been associated with elevated risk (Lipworth, 1995). In fact, women who have been actively menstruating for 40 or more years are thought to have twice the risk of developing breast cancer than women with 30 years or less of menstrual activity (Henderson et al, 1996). Other reproductive events have also shown a linear association with risk for breast cancer (Wohlfahrt, 2001). Specifically, women who gave birth for the first time before age 18 experience one-third the risk of women who have carried their first full-term pregnancy after age 30 (Boyle et al, 1988). The protective effect of earlier first full-term pregnancy appears to result from the reduced effect of circulating hormones on breast tissue after pregnancy (Kelsey, 1993).

Diet, and particularly fat intake, is another factor suggested to increase a woman's risk for breast cancer. Currently, a hypothesis exists that the type of fat in a woman's diet may be more important than her total fat intake (ACS 1998; Wynder et al, 1997). Monounsaturated fats (olive oil and canola oil) are associated with lower risk while polyunsaturated (corn oil, tub margarine) and saturated fats (from animal sources) are linked to an elevated risk. However, when factoring in a woman's weight with her dietary intake, the effect on risk becomes less clear (ACS 1998). Many studies indicate that a heavy body weight elevates the risk for breast cancer in postmenopausal women (Kelsey, 1993), probably due to fat tissue as the principal source of estrogen after menopause (McTiernan, 1997). Therefore, regular physical activity and a reduced body weight may decrease one's exposure to the hormones believed to play an important role in increasing breast cancer risk (Thune et al, 1997).

Aside from diet, regular alcohol consumption has also been associated with increased risk for breast cancer (Swanson et al, 1996; ACS 2001). Women who consumed one alcoholic beverage per day experienced a slight increase in risk (approximately 10%) compared to non-drinkers, however those who consumed 2 to 5 drinks per day experienced a 1.5 times increased risk (Ellison et al., 2001; ACS 2001). Despite this association, the effects of alcohol on estrogen metabolism have not been fully investigated (Swanson et al, 1996).

To date, no specific environmental factor, other than ionizing radiation, has been identified as a cause of breast cancer. The role of cigarette smoking in the development of breast cancer is unclear. Some studies suggest a relationship between passive smoking and increased risk for breast cancer; however, confirming this relationship has been difficult due to the lack of consistent results from studies investigating first-hand smoke exposure (Laden and Hunter, 1998).

Studies on exposure to high doses of ionizing radiation demonstrate a strong association with breast cancer risk. These studies have been conducted in atomic bomb survivors from Japan as well as patients that have been subjected to radiotherapy in treatments for other conditions (i.e., Hodgkin's Disease, non-Hodgkin's Lymphoma, tuberculosis, post-partum mastitis, and cervical cancer) (ACS 2001). However, it has not been shown that radiation exposures experienced by the general public or people living in areas of high radiation levels, from industrial accidents or nuclear activities, are related to an increase in breast cancer risk (Laden and Hunter, 1998). Investigations of electromagnetic field exposures in relation to breast cancer have been inconclusive as well.

Occupational exposures associated with increased risk for breast cancer have not been clearly identified. Experimental data suggests that exposure to certain organic solvents and other chemicals (e.g., benzene, trichloropropane, vinyl chloride, polycyclic aromatic hydrocarbons (PAHs)) causes the formation of breast tumors in animals and thus may contribute to such tumors in humans (Goldberg and Labreche, 1996). Particularly, a significantly elevated risk for breast cancer was found for young women employed in solvent-using industries (Hansen, 1999). Although risk for premenopausal breast cancer may be elevated in studies on the occupational exposure to a combination of chemicals, including benzene and

PAHs, other studies on cigarette smoke (a source of both chemicals) and breast cancer have not shown an associated risk (Petralia et al, 1999). Hence, although study findings have yielded conflicting results, evidence does exist to warrant further investigation into the associations.

Other occupational and environmental exposures have been suggested to confer an increased risk for breast cancer in women, such as exposure to polychlorinated biphenyls (PCBs), chlorinated hydrocarbon pesticides (DDT and DDE), and other endocrine-disrupting chemicals. Because these compounds affect the body's estrogen production and metabolism, they can contribute to the development and growth of breast tumors (Davis et al, 1997; Holford et al, 2000; Laden and Hunter, 1998). However, studies on this association have yielded inconsistent results and follow-up studies are ongoing to further investigate any causal relationship (Safe, 2000).

When considering a possible relationship between any exposure and the development of cancer, it is important to consider the latency period. Latency refers to the time between exposure to a causative factor and the development of the disease outcome, in this case breast cancer. It has been reported that there is an 8 to 15 year latency period for breast cancer (Petralia 1999; Aschengrau 1998; Lewis-Michl 1996). That means that if an environmental exposure were related to breast cancer, it may take 8 to 15 years after exposure to a causative factor for breast cancer to develop.

Socioeconomic differences in breast cancer incidence may be a result of current screening participation rates. Currently, women of higher socioeconomic status (SES) have higher screening rates, which may result in more of the cases being detected in these women. However, women of higher SES may also have an increased risk for developing the disease due to different reproductive patterns (i.e., parity, age at first full-term birth, and age at menarche). Although women of lower SES show lower incidence rates of breast cancer in number, their cancers tend to be diagnosed at a later stage (Segnan, 1997). Hence, rates for their cancers may appear lower due to the lack of screening participation rather than a decreased risk for the disease. Moreover, it is likely that SES is not in itself the associated risk factor for breast cancer. Rather, SES probably represents different patterns of reproductive choices, occupational backgrounds, environmental exposures, and lifestyle factors (i.e., diet, physical activity, cultural practices) (Henderson et al, 1996).

Despite the vast number of studies on the causation of breast cancer, known factors are estimated to account for less than half of breast cancers in the general population (Madigan et al, 1995). Researchers are continuing to examine potential risks for developing breast cancer, especially environmental factors.

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Appendix D

RISK FACTOR INFORMATION FOR SELECTED CANCER TYPES

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Cancer Reference Information

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Detailed Guide: Skin Cancer - Melanoma

What Are The Risk Factors for Melanoma?

A *risk factor* is anything that increases a person's chance of getting a disease such as cancer. Different cancers have different risk factors. Smoking is a risk factor for cancers of the lung, mouth, larynx, bladder, kidney, and several other organs. But having a risk factor, or even several, does not mean that a person will get the disease.

Exposure to Sun

Sunlight contains ultraviolet radiation (UV), which can damage the genes in your skin cells. Tanning lamps and booths are another source of ultraviolet radiation. People with excessive exposure to light from these sources are at greater risk for skin cancer, including melanoma. The amount of UV exposure depends on the intensity of the radiation, length of time the skin was exposed, and whether the skin was protected with clothing and sunscreen.

Moles

A nevus (the medical name for a mole) is a benign (noncancerous) melanocytic tumor. Moles are not usually present at birth but begin to appear in children and teenagers. Having many moles makes a person more likely to develop melanoma.

One kind of a mole called a dysplastic nevus, or atypical mole, particularly increases a person's risk of melanoma. Dysplastic nevi (nevi is the plural of nevus) often look a little like normal moles but also typically look a little like melanoma. (Refer to the section "Can Melanoma Skin Cancer Be Found Early?" for descriptions of the appearance of moles and melanomas.) They can appear in areas that are exposed to the sun as well as those areas that are usually covered, such as the buttocks and scalp. They are often larger than other moles.

Dysplastic nevi often run in families. If you have family members with many dysplastic nevi you have about a 50% chance of developing these nevi. Someone with one or more dysplastic nevi and with at least 2 close relatives with melanoma has a 50% or greater risk of developing melanoma. Lifetime melanoma risk is estimated to be between 6% and 10% for those with dysplastic nevi, depending on age, family history, the number of dysplastic nevi, and other factors. People with this condition should have especially thorough and frequent skin examinations by a dermatologist. In some cases, full body photographs are taken at regular intervals to help the doctor recognize which moles are changing and growing. Patients should be taught to do monthly skin self exams, and be counseled about sun protection.

Moles present at birth are called *congenital melanocytic nevi.* The lifetime risk of developing melanoma for people with congenital melanocytic nevi has been estimated by some researchers to be about 6%. However, this risk is affected by the size of a congenital nevus. People with large congenital nevi have a greater risk, while the risk is smaller for those with small nevi. Congenital nevi are sometimes removed by surgery so that they do not become malignant. Whether or not doctors recommend removing a congenital nevus is influenced by several factors including its size, location, color, and texture. Congenital nevi that are not removed should be examined at regular intervals by a dermatologist and the patient should be taught how to do monthly skin self exams.

The chance of any single mole turning into cancer is very low. However, anyone with lots of moles or with large moles has an increased risk for melanoma.

Fair Skin, Freckling, and Light Hair

The risk of melanoma is about 20 times higher for whites than for African Americans. This is because skin pigment has a protective effect. Whites with red or blond hair or fair skin that freckles or burns easily are at increased risk.

Family History

Risk of melanoma is greater if 1 or more of a person's first-degree relatives (mother, father, brother, sister, child) have been diagnosed with melanoma. Around 10% of all people with melanoma have a family history of melanoma. Sometimes this can be caused by a family lifestyle of frequent sun exposure, a family with fair skin, or a combination of both factors. Less often it is due to a gene mutation along with any sun exposure. Gene mutations have been found in anywhere from 10% to 40% of families with a high rate of melanoma. Most experts do not recommend genetic testing in these families. Rather, people with a strong family history of melanoma should have periodic skin exams by a dermatologist. They should learn how to do thorough skin self exams, and be particularly careful about sun protection.

Immune Suppression

People who have been treated with medicines that suppress the immune system, such as organ transplant patients, have an increased risk of developing melanoma.

Age

Although melanoma is less related to aging than most other cancers, it is still more likely to occur in older people. But this is one of the few cancers that is also found in younger people. In fact, melanoma is one of the most common cancers in people younger than 30. Melanoma that runs in families may occur at a younger age.

Gender

Men have a higher rate of melanoma than women.

Xeroderma Pigmentosum

Xeroderma pigmentosum (XP) is a rare, inherited condition resulting from a defect in an enzyme that repairs damage to DNA. People with XP have a high risk for both melanoma and keratinocyte (basal cell and squamous cell) skin cancers. Because people with XP are less able to repair DNA damage caused by sunlight, they can develop many cancers on sun-exposed areas of their skin. These facts help explain the connection between sunlight and skin cancer.

Past History of Melanoma

A person who has already had melanoma has an increased risk of developing melanoma again.

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